

Crown I-Tech Series Power Amplifiers

Class-I topology and plenty more onboard

By Jeff Kuells

Crown International isn't known for knee-jerk reactions to market trends or demands. Rather, the company takes its time, researches the best technology available, perfects it and only then comes to market. The development path of the recent I-Tech Series of power amplifiers proved no different.

For more than 15 years, touring companies and contractors have grown comfortable with the Crown Macro-Tech line of amplifiers. When the MA-5002VZ came out in 1992, it was hard for many to believe this 3U amp produced 5,000 watts (4-ohm bridge-mono). Users were power hungry, and no one cared that it

weighed 78 lbs. Fast-forward to 2004, when the company debuted an amp that once was only a dream for the professional audio world – the I-Tech I-T8000 – capable of generating 8,000 watts (8-ohm bridge-mono) in a 2U package weighing just 28 lbs. Now that's advancement!

Taking operator convenience a step further, the I-Tech Series (comprised of I-T4000 and I-T6000 models in addition to I-T8000) also incorporates features such as digital and analog inputs, digital signal processing (DSP) and network control. This makes a lot of sense, and as a result, the I-Tech Series can provide significant savings when

looked at in terms of an overall system cost analysis. A more recent upgrade is front-panel control and LCD display, making these amps much more intuitive to use.

While the I-Tech Series was introduced a few years ago, I didn't want to review it immediately. Instead, I always prefer that the inevitable new product "bugs" be worked out first, and indeed, Crown informed me that there were a few initial glitches that have now been fully addressed.

CHANGING POWER PERCEPTIONS

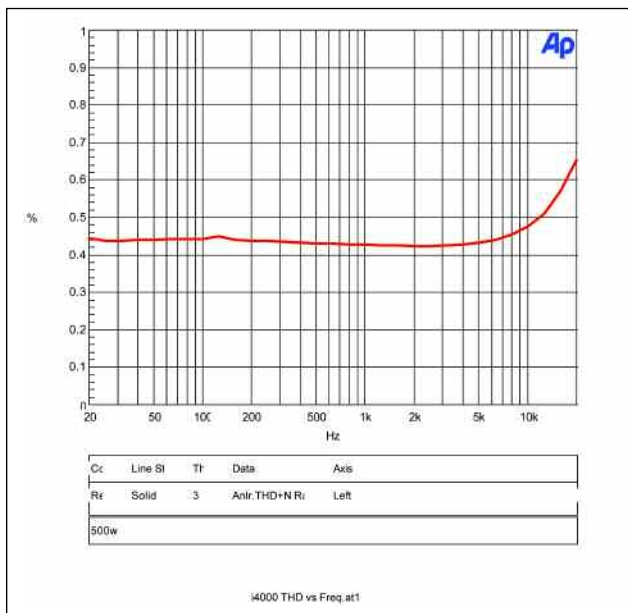
How we evaluate an amp's output power has changed in recent years. Prior to being outfitted with switch-mode power supplies, amplifiers were evaluated with a combination of RMS (Root Mean Square) criteria and how long they could sustain a 1 kHz sine wave at full output for a specific amount of time. Amps older than 10 years were designed with these stringent tests in mind, but since then we've determined that the tests were not completely practical for real world applications.

Active loudspeaker amplification requirements have changed from continuous sine wave to peak (or dynamic) power, with one of the main goals being a smaller and lighter overall loudspeaker package (onboard amp included). Most consumers don't really care if an amp can sustain a sine wave at full output for more than a few seconds, but rather, they want the

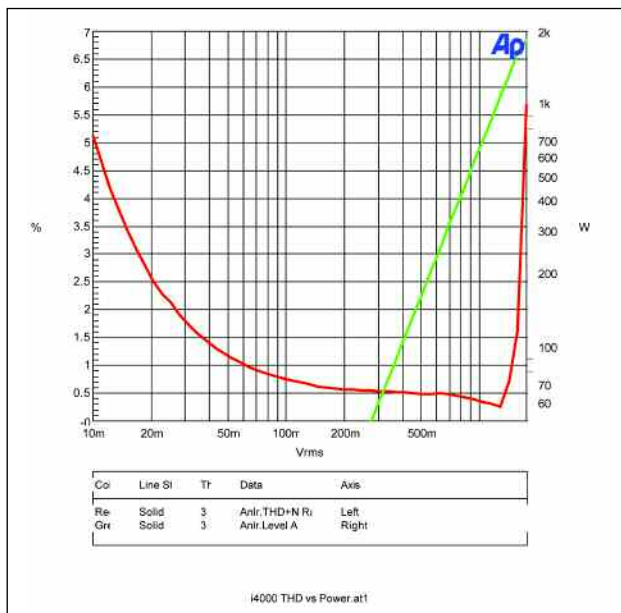


Crown's I-Tech I-T4000 power amplifier.

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I-Tech 4000 THD versus frequency measured at 8 ohms.



I-Tech THD versus power measured at 8 ohms.

loudspeaker to deliver dynamic performance. Many amp designers already knew this years ago, but until switch-mode power supplies came along, there wasn't much that could be done to make amps smaller and lighter without seriously compromising performance.

The advent of switch-mode supplies, designed to deliver an immense amount of current for short periods of time, has impacted both active loudspeakers and standalone amps. The key is the recovery time of the power supply to reproduce the next cycle, and combined with high DC rails, an extreme amount of power can be delivered for a couple of seconds. Meanwhile, size reduction is mainly due to use of an efficient amplifier stage that reduces the need for bulky heatsinks.

CLASS-I TOPOLOGY

For many years the market was complacent in using dependable Class-AB and Class-H amp topologies, and then along came Class-D type topology. Now comes Crown's patented switch-mode Balanced Current Amplifier (BCA) Class-I topology that's at the heart of the I-Tech Series, which the company claims delivers better efficiency over conventional Class-D designs due to its unique circuit topology. (By the way,

Class I was first used in Crown K Series amps.)

Traditional high-power, non-switching amps use separate transistor banks between positive and negative supply rails, with the positive loudspeaker output connected between transistor banks. In the simplest terms, Class-D transistor banks are alternately switched on and off, using pulse width modulation and a passive filter circuit between the transistors and the loudspeaker connection. Class-I is like two Class-D amplifiers in a bridge configuration, except the load is still referenced to ground. But what's really special about Class-I is the ability to accept power supplies up to +/-200 volts. (For more information, check out the company's technical papers on BCA at www.crownaudio.com.)

INPUT OPTIONS, DSP & NETWORKING

As noted, I-Tech amps offer both analog and digital inputs. AES/EBU digital inputs allow direct connection to a digital console, keeping the signal path in one domain, and there's also a digital link for looping signal to other amps. Meanwhile, networking is functional over standard CAT-5 cable, controlled via Crown IQwic software. If more than one amp is on the network, a standard network switch is needed at

the amp rack. (CobraNet is also available in "CN" designated models.)

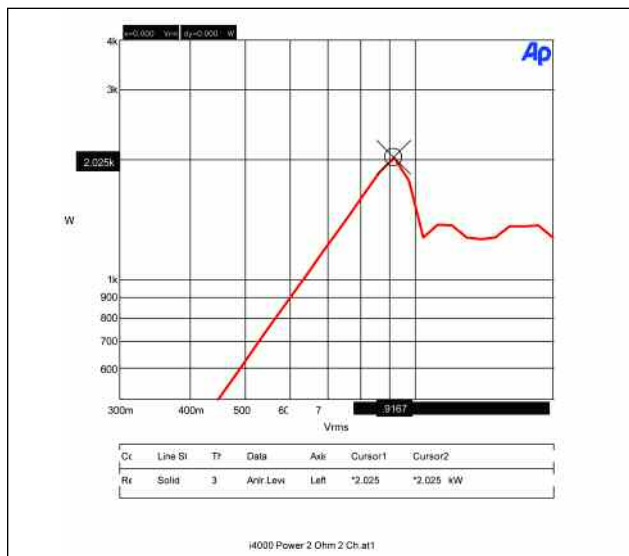
Reducing the need for rack components and wiring, the 24-bit conversion with 32-bit, floating-point DSP processing has 64 assignable filters with nine different filter types, and it also includes all-pass filters as well as more than two seconds of delay per channel and dual uncorrelated-noise and sine-wave generators. Push-button presets simplify the setup, and front-panel buttons allow the setting of basic functions like attenuation, limiters, modes and sensitivities. (Note that a PC is needed for DSP programming.) Also included are innovative amp functions such as real-time load monitoring, temperature readings and fault indications.

ON THE BENCH

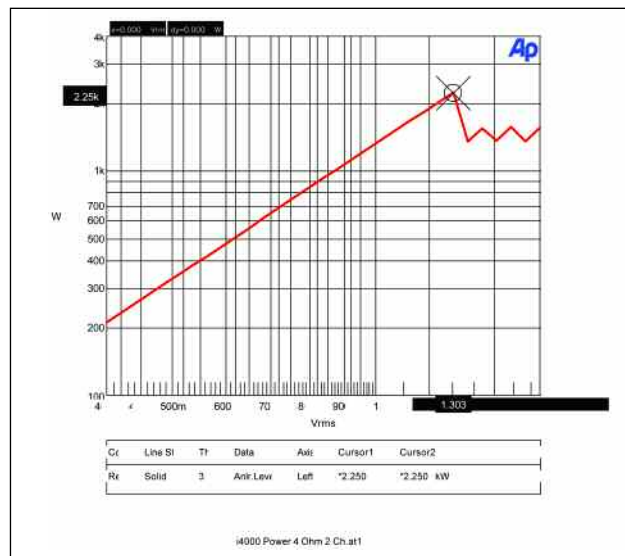
During 20 years of testing amps, I've developed a basic protocol methodology that's allowed me to examine differences in technologies as they emerge over time. However, I also try to keep it simple and sort out what is relevant to end users.

While the I-Tech Series offers many intriguing features, my focus is the "meat and potatoes" – the high output power with low AC line power requirements. As noted earlier, the line consists of three models, and I chose the I-T4000 because it fits my

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I-Tech 4000 power sweep at 2 ohms, both channels.



I-Tech 4000 power sweep at 4 ohms, both channels.

demo applications, plus 2,000 watts per channel is plenty to see how the series performs. The I-T4000 utilizes a wide-range AC power input, meaning it can operate from 100 volts to 277 volts while maintaining the same specifications. I ran two sets of AC line voltage tests to see if there were any abnormalities between 120 volts and 220 volts, and also should point out that because the power supply is intended to operate under sagging line conditions, I didn't use a variable AC transformer to maintain the AC line. (In testing older designs, I've always had to maintain the AC line voltage under load to meet the power specifications.)

To my surprise, when measuring total harmonic distortion (THD) versus power, I didn't see any variance in THD at any applied AC primary voltage. The line did sag considerably, but the output power and THD remained consistent, thus proving the proprietary Power Factor Correction (PFC) circuit was doing a fine job. THD versus frequency was a bit high, but realize that the input signal path was operating in the digital domain. Meanwhile the noise floor was very low at its 60 Hz peak of 1 millivolt, which is outstanding for any amp.

When and where to measure maximum power output in Class-D amps is a judgment call. In the past, it was a very specific measurement – we looked for the point where the sine

wave started to square off. With these newer designs we, however, high-frequency osculation bursts and power supply timing issues must be taken into consideration. At every level on the I-T4000, I measured at least 200 watts more than the specified rating. (And I was also pleased that Crown is conservative with power ratings.)

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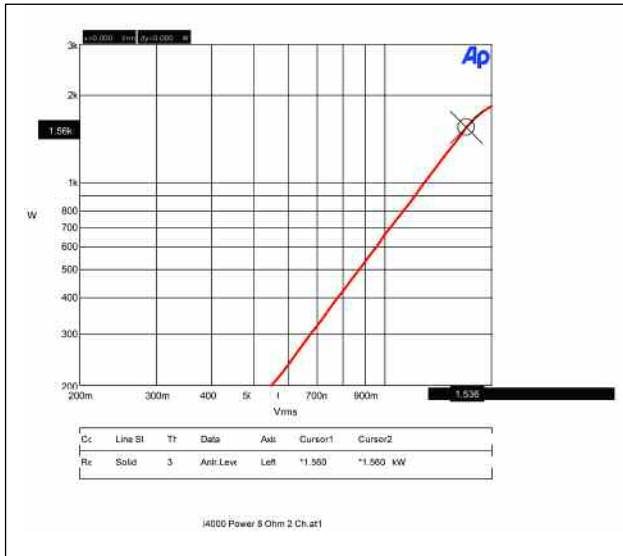
Crown states that just 20-amp AC (120-volt) service is needed; again this is a judgment call. When testing the I-T4000 at 8 ohms with one channel driven, I measured 1,620 watts. The current draw was 19 amps. With two channels driven at 8 ohms, it peaked my current meter but did not trip the breaker.

Now, one might ask, "How can Crown claim only 20-amp service is

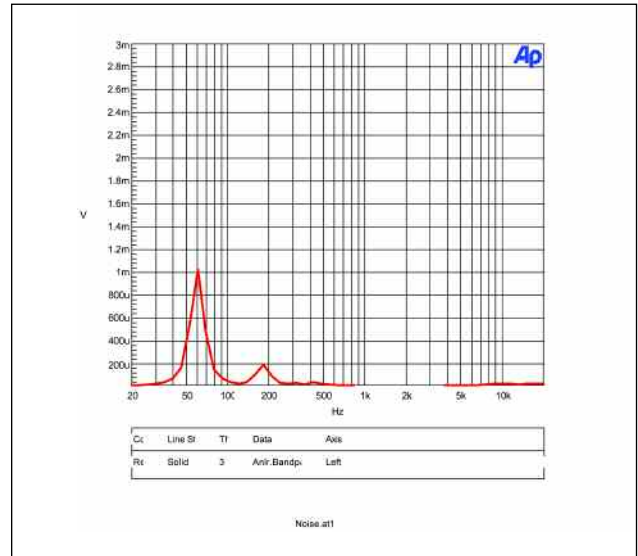
needed to power the amp at lower impedances?" But keep in mind we're dealing with peak power, and AC main breakers can handle way more current than rated for short periods of time or until they heat up. The I-T4000 is only delivering power for short periods of time, while also getting every bit of energy from the 60 Hz waveform because the PFC circuit utilizes the complete AC waveform – not just the peaks.

When testing 4-ohm and 2-ohm operation, I was able to trip the breaker, but remember I was testing maximum power over longer periods of time. The audio duty cycle is less demanding than my bench test. Crown also provided us with this clarification: "For those concerned about why 20-amp AC inlets are used, it's important to understand that all amp manufacturers are faced with testing products against the same IEC safety standard, and that the 1/8 power test is what ultimately dictates what plug we use and what AC inlet is required for each amp. IEC, UL, and CSA all use the 1/8 power sign wave bench tests as a way to simulate high-duty-cycle, real-world music conditions over time." And, the I-Tech manual offers an informative section on 1/8 and 1/3 power current draw.

For both 4-ohm and 2-ohm power testing, I simply plugged the amp into a 220-volt wall source. It was great not having to rewire the amp, and the unit



I-Tech 4000 power sweep at 8 ohms, both channels.



Noise measurement for the I-T4000.

exceeded all power ratings provided in the power charts. I won't say I-Tech can't be used on a 20-amp, 120-volt source, but it's always better to provide any amp with as much AC power as possible.

IN THE FIELD

I do PA announcement for football games at a local California high school. This is a new facility, still under construction and with no audio system, which made for tough condi-

tions because the AC power must be fed to the stadium via a 250-foot, 8-gauge power cord.

Further, distribution is done with a ground-fault interrupter (GFI) spider box, and as many of you know, GFIs



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Jeff Kuells – the Amp Man!

and amps are not a good combination. To make things worse, the distro box is 50 feet from where I needed to be, so I ran a 10-gauge power cord on a 20-amp circuit to the audio rack. This combination of long power cord runs and GFI circuits would really test the I-Tech power supply's PFC circuit.

With home and visitor seating located together, the PA only has to cover one side of the stadium. I loaded one channel of the amp with

three Atlas Sound AH Series stadium loudspeakers (8-ohm, 15-inch LF, 1-inch HF) and the other channel with a pair of double 18-inch subwoofers. This is a tough load for any amp, and in case of a problem, I had extra amps available.

My biggest concern: would the I-T4000 be able to deliver sufficient power from a limited AC source without tripping the GFI or AC breaker? I monitored the AC line voltage; it

remained fairly stable under the circumstances. When the system was in idle, the AC line voltage was 121 volts, and with the clip lights slightly flashing, the line voltage dropped to 107 volts. To my surprise, the breakers never tripped. Obviously it was hard to tell how much power the amp was delivering, but the loudspeakers had all the power they could handle.

As a result, I can honestly say the I-Tech delivered as promised and passed this difficult field test with flying colors. The combination of efficient Class-I output stage along with the switch-mode PFC power supply made it possible to more than adequately power a system for a simple but important event in "Small Town USA."

SUMMARY

Crown I-Tech is not inexpensive; however, keep in mind that not only do these amps represent a significant upgrade in terms of amp capability, they also can replace several pieces of additional outboard gear while saving rack space (and when applicable) truck-pack space. It all adds up to a very appealing purchase and a modern marvel of engineering. ■

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How to be heard in a crowd.

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